PROJECT NUMBER : 0008
PROJECT TITLE : Computer Applications Division
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I. Expert Systems Development

A. **Objective:** Develop an Expert System for Cigarette Design.

B. **Results:** We have continued to incorporate into CigDES.1 the filter design features of version 8.1 of the Fortran cigarette model. All filter design functionality of the control cigarette design has been implemented. A few features of the prototype filter design still remain to be incorporated into KEE. In response to user request, we have also implemented a set of cigarette performance analysis functions which allow the user to explore how cigarette performance characteristics relate to cigarette design parameters. These features are based on the goal-directed search feature of CigDES which maintains a trace of the explored cigarette designs and their corresponding performance evaluation. After a goal-directed search is conducted, the user can command CigDES to graph, show, save, or print a mapping of the values of a specified design parameter against one or all other design or performannce parameters.

C. **Conclusions:** The implementation of the correlation functions illustrates the power of KEE to deal with knowledge-based domains such as cigarette design. The high level implementation features of KEE made it possible to implement the new cigarette performance analysis functions in a matter of days. Once the basic interface between CigDES and the Fortran model is complete, these high level programming features of KEE will allow us to respond to user needs quickly to provide new functionality to both facilitate and enhance the cigarette design process.

D. **Plans:** After the new features have been reviewed, we will work with the primary user to test and evaluate the new version of CigDES.

E. **References:** Palesis, J.A., Dwyer, R.W., Leister, D.L., and Kao, J.W., "Transforming Mathematical Product Evaluation Models Into Expert Systems for Product Design," Proceedings of the 3rd International Conference on Industrial & Engineering Applications of Artificial Intelligence and Expert Systems, pp. 404-415, 1990.

II. Neurocomputing

A. **Objective:** Develop programming techniques for use of the HNC ANZA Plus Neurocomputer and Neurosoftware. Investigate potential applications of neurocomputing to R&D problems, and apply where appropriate.

B. **Results:** The training methodology for Learning Vector Quantization was improved in several respects - principally the way in which the "repulsion" and "distance bias"

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terms are controlled during learning. This avoids erroneous and inefficient weight adjustments early in training, and allows the network to focus on the decision boundaries rather than on equiprobability in the latter phase of training. As a result, classification performance is somewhat improved and training time is significantly reduced. Also, an "LVQ Test" program was developed to automate the manual process of performing n-fold cross-validations for various Kohonen layer sizes per class.

The analysis of data from the Selective Filtration Study using Learning Vector Quantization and pattern classification techniques is nearly complete. Neural networks were developed to classify chromatograms of model cigarettes according to their wrapper type, filter type, and overall liking.

C. Conclusions: Learning Vector Quantization and other pattern classification techniques can be successfully used to help understand the relationship between cigarette design, cigarette analyticals, cigarette chemistry (e.g., chromatography), and subjectives.

D. Plans: Complete pattern classification analysis for Selective Filtration Study, and issue a report.

E. References: Research report 91-025, A Neural Network Model of Cigarette Liking.

III. CTSD CIGARETTE LENGTH INSTRUMENT

A. Objective: Develop software to acquire data from the Honeywell HVS 256 Edge/Width Gauge. This instrument will replace the current cigarette length instrument and data acquisition system.

B. Results: A new base for the Honeywell HVS 256 was received from Development Engineering and the data acquisition software was tested. The instrument can now measure cigarettes from 67mm to 120mm. It has been installed in the CTSD Physical Testing lab and personnel have been trained. Information from the data acquisition system is updating the CTSD LAS2 database. This project is complete.

C. Plans: Provide support as needed.

D. References: CAD Project Request #4226

IV. CTSD GAS PHASE/FTIR FIVE-PORT SMOKERS

A. Objective: Develop a new data acquisition system (DAS) for the five-port smokers in the Cigarette Testing Services Division (CTSD) gas phase laboratory.

B. Results: Two CTSD Gas Phase/FTIR Five-port Smokers using Laser Precision FTIR instrumentation are fully operational. This includes barcode support for sample identification, loading of results into the CTSD LAS2 database and training of lab

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personnel. Also, communications with the Eagle smoker controller were refined as were the peak detection algorithms.

C. **Plans:** Install a third and final unit in late August.

D. **References:** CAD Project Request #3979

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